Nitrogen mysteries in urban grasslands

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Urban grasslands are an extremely common, but poorly studied ecosystem type. Many receive high rates of fertilizer, creating concerns about nutrient runoff and greenhouse gas emissions. Recent research has been focused on long-term study plots to evaluate multiple ecological variables in different components of the urban landscape.

Areas of turf-forming species created and maintained by humans for aesthetic and recreational (not grazing) purposes, i.e. "urban grasslands" are an extremely common, but poorly studied ecosystem type. There are over 150,000 km^2 of urban grasslands in the U.S. and many receive high rates of fertilizer, creating concerns about nutrient runoff to streams, lakes, and estuaries and emissions of greenhouse gases such as nitrous oxide (N_2O) to the atmosphere. Most turfgrass research has been done on highly controlled research plots which can be very different than actual urban grasslands which have highly variable management regimes and physical, biological, and chemical conditions.

In the Baltimore Ecosystem Study (BES, beslter.org), one of two urban components of the U.S. National Science Foundation (NSF) Long Term Ecological Research (LTER) network, scientists from the Cary Institute of Ecosystem Studies (Peter Groffman), the U.S. Forest Service (Richard Pouyat, Ian Yesilonis) and the University of North Carolina (Lawrence Band) established a series of long-term study plots to evaluate multiple ecological variables in different components of the urban landscape. An NSF-funded Research Experience for Undergraduates student (Candiss Williams) used these plots for a summer research project. Forest plots were established in urban and rural parks for

comparison with grass plots that vary in management intensity, ranging from unfertilized and infrequently mowed to high levels of fertilizer and herbicide input and frequent mowing. Plots were instrumented with lysimeters to measure nutrient leaching losses, soil chamber bases for measuring soil/atmosphere fluxes of N_2O, and sensors for soil temperature and moisture. Results on nitrate (NO^{3-}) leaching and N_2O fluxes over a period of significant climatic variability (2001) were presented in a paper in the September-October 2009 issue of *Journal of Environmental Quality*.

Differences in NO^{3-} leaching and N2O flux between forests and grasslands were not as high as expected given the higher frequency of disturbance and fertilization in the grasslands. Annual NO^{3-} leaching was usually higher in grass than forest plots, but in a very dry year and when a disturbed forest plot was included in the analysis, differences were small and insignificant. There were few differences in N_2O between grass and forest plots, and markedly higher fluxes in wet years. In a dry year, N losses from the grasslands were equal to less than 10% of the amount of N applied in fertilizer, and even in a wet year, losses were less than 40%. Lots of N appears to be retained in urban grasslands, likely because they support rapidly growing vegetation and high stocks of soil organic matter.

While surprising, these results do not suggest that we should not be concerned about the environmental impacts of urban grasslands. If leaching losses equal 40% of the amount of N applied in fertilizer, and high rates of fertilizer (e.g., 200 kg N ha-1 yr-1) are applied, lawns will have a strongly negative effect on receiving water quality. However, our results suggest that urban grasslands have considerable capacity for N retention that should be studied and considered in evaluations of land-use change and in the development of management plans for urban and suburban watersheds.

More information: View the study abstract at http://jeq.scijournals.org/cgi/content/abstract/38/5/1848.

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